Framework Model of Integration xRM with GIS

BY

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THESIS A
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Writing this thesis has been both challenging and truly rewarding in terms of developing my experience, projects and knowledge within this area which around six years and more than ten xRM projects. I hope this thesis will make an attention for the reader and create an interest in reading about xRM & GIS integration in level of enterprise solutions.

DEDICATIONS

This thesis is dedicated to - My Parents, Who are the reason why I am here, and to my beautiful daughter Sarah who always keeps asking the question „Why?“ , and… my wife “Esra” and our coming baby! for their love, endless support, and understanding…

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Abbreviation/Glossary

Used to be	Abbreviation
Line Of Business	LOB
Customer Relationship Management.	CRM
eXtended Relationship Management.	xRM
Geographic Information System	GIS
Enterprise Resource Planning	ERP
Supply Chain Management	SCM
Structured Query Language	SQL
Service Object Manager	SOM
Application Programming Interfaces	API
Data Source Name	DSN
Data Base	DB
Human Resource Management	HRM
Microsoft Developer Network	MSDN
Dynamic Link Library	DLL
Transmission Control Protocol	TCP
Internet Protocol	IP
Global Positioning System	GPS
Environmental Systems Research Institute	ESRI
Microsoft	MSFT
Application service provider	ASP
Data Warehouse	DW
Decision Support Systems	DSS
Rational Unified Process	RUP
Electronic Commerce	EC
Electronic Data Interchange	EDI
Instant Messaging	IM
Knowledge Management	KM
Object-Oriented Programming	OOP
Open Source Software	OSS
Outsourcing	OUTS
Radio Frequency Identification	RFID
Infrastructure as a Service	IaaS
Platform as a service	PaaS
Software as a service	SaaS
Return On Investment	ROI
Total Cost Ownership	TCO
Protected Geographical Indication	PGI
Web Coverage Service	WCS
Web Map Service	WMS

User Experience Components

- Office Integration
- Outlook Sync
- Standard Clients & Devices
- Common Navigation & SiteMap
- User Functionality & Tools
- Offline Capabilities, without map
- Language Packs
- Accessibility

Access and Security Components

- Active Directory
- Access Controls / Authentication
- VPN-less Accessible (SSL)
- Bulk User Management
- Role Management
- Role-based Security
- Hierarchical Security
- Deep data controls

Data Modeling Components **Extensibility Components**

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Framework Model of Integration xRM with GIS

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ABSTRACT

Relations Management is divided into several types; including Customer Relations, Suppliers, and Employees...etc. The development of these relations has been rapidly commensurate with the technological development of infrastructure to the world of information technology that impacts positively the development of these relations and the speed of decision-making time. On the other hand, the Relations Management has developed rapidly for maintaining the existing customers and attracting new customers as well to campaign propaganda and return the analytical results for those campaigns. It also provides technical support to all customers. After that, the revolution in Infrastructure Information and the use of wireless technologies have appeared.
The Relationship Management System is one of the most important solutions for monitoring the activities of Sales and Marketing, so that it works in the first instance to let the Client be the primary focus. Accordingly; the institution can use its integrated database in order to achieve the completion of all business sales and follow-up activities, open accounts for customers, keep all events that happen on daily basis, issue reports, track the staff performance of sale, keep the good relationship with the client and lastly monitor the performance of the entire department.

With the development of Relations Management Solutions; there are some gaps which have appeared and adversely affected the performance of these kinds of solutions and their ability to assist in the decision-making in the right time and place. In the event of pandemic spreading or natural disasters, these solutions will fall to determine the geographical locations an extract the geographical information and metadata for specific goals in order to deal with these outputs at all levels, whether governmental or private. Align IT expenditures with business objectives and deliver fully featured complex line-of-business (LOB) applications with a platform that combines prebuilt configurable functionality on a highly flexible service-oriented architecture. Faced with a difficult choice between packaged software and custom development, IT Departments are often forced to compromise on capabilities, budget, and delivery time for LOB applications. xRM is designed to help organizations get the best of both worlds with a flexible platform that rapidly accelerates application delivery.

Each of the above and many of the reasons which will be explained later in details, shows that there is an urgent need to solve these problems and gaps by creating new ways based on the achievements and developments in the Infrastructure of Modern Information Technology and harness these ways to collect, enter, process, analyze, view, and extract the geographic information and metadata for specific goals then schedule them an appropriate format to be sent accordingly. On the other hand, this information will be got in suitable time and right place using the Geographic Information Systems, connected with the Relations Management Systems.

This thesis considers a practical implementation of the problems which face the public and private sectors, in other words, it is an output of practical experience for real projects that belong to large companies (Enterprises) and government institutions.
In conclusion, applying the idea of the proposed model will lead to faster decision-making in order to reach an accurate metadata. Moreover, this will save time and effort and reduce the costs that may result from designing or purchasing each system on its own.

تص يًى ورًج انتكايم يا بي ا ظ ةً ادراة انعلاقات و ا ظ ةً ان عًهويات انجغرافية

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كا وَ الأول 2010

ان هًخص

ذ مِس إداسج ا □ٌلالاخ تشى □اا ٌّ □ذج ا ٌأ□: □لالاخ ا □ٌ لّاء ٌ ا ٌّسد ٠ ٌ ا ٌّغف ١ ...ا خٌ, مٌذ ذ ذطٌ ٠ش زٌ ا □ٌلالاخ
تشى سش ٠ □ ٠ر إسة □ِ ا رٌطٌس ا رٌى ٌٍ ٌّظ□ ثٌٍ ١ح ا رٌ□ر ١ح □ٌا ذى ٌٍ ٌّظ ١١١ □ٌ ٌٍ اِخ ا زٌٌ اشش ا ٠عاتا □ ٌٍ ذطٌ
٠ش زٌ ا □ٌلالاخ ٌ □ ٌ سش□ح اذخار ا مٌشاس ف□ ا ٌٌلد ا ٌإسة تذأخ إداسج □لالاخ ا □ٌ لّاء تا رٌطٌس ا سٌّش ٠ □ ت□ٌز
ذمٌ تا □ٌفاظ □ ٌٍا □ٌ لّاء ا □ٌا ٌ١١ ٌ اسرمطاب □ لّاء ظذذ ٌ ا مٌ ١١ تا □ٌ لّاخ ا ذٌ□ائ ١ح ٌ ا □ٌدج تاٌٍرائط ا رٌ□ ِ١ ح رٌ ٍِا □ٌ
لّاخ. ٌ ذمذٌ ا ٠ □اا ذٌ□ ا فٌ □ِ عٌ ١□ ا □ٌ لّاء, ش غٌشخ ا ٌٌ سسج ف□ ا ثٌ ١ِح ا رٌ□ر ١ح رٌى ٌٍظ ١١١ □ٌ ٌٍ اِخ ٌ اسرخذا ا
ا ١ح ا لّاس ىٍ ا اخ ١ِ رٌم)Wireless.(

٠ □رثش □ٌأ إداسج اي□لالاخ ٌا□ذا أ ا □ٌ ٌٍي ا رٌ□ ذر ١ □ رِات□ح شأطاخ ا ثٌ ١ □ ٌا رٌس ٌ ٠ك ت□ ١س ٠ □ ف□ ا
دٌسطح الأٌ ٌٌ □ ٌٍظ□ ا □ٌ ١ ِ□ٌس الا رٌ ٢ الأساس□ ف ١سا□ذ □ ٌٍ ذىٌ ٠ لا□ذج ت ١١ أخ رِىا حِ ذسرط ١□ □ طش
٠م ا شٌأج إ عًاص وافح الأ□ اي ا ثٌ ١ □ ١ح ٌا□ اي ا رٌات□ح ٌفر□ ا □ٌساتاخ □ٌٍ لّاء ٌ□فع ظ١ٌ□ الأ□ذاز ا رٌ□ ذر تشى
٠ ٌ □ِ ٌإطذاس ا رٌماس ٠ش ٌذشذ ١ة الأ□ اي ٌ □ِا ٠ حِ وفاءج ا ٌّغف ١ ف□ أداء أ□ اي ا ثٌ ١□ ٌإتماء ا □ٌلالح ا طٌ ١ثح
□ِ ا □ٌ ١ ٌأداء ا ٌّس تأو ٌٍّ

ش ٌذخ ش□ ح ذطٌس ا ٌّش ع ١اخ ٌ اي□ ٌٍي ا خٌاطح تادساج ا □ٌلالاخ غ ٌٌس ت□غ ا قٌع ٌاخ ا رٌ□ ذؤشش س ثٍا □ ٌٍ اداء
ز ٌ ا □ٌ ٌٍي ٌ لذسذ ٌا □ ٌٍ ا سٌا□ذج □ ٌٍ اذخار ا مٌشاس ف□ ا ٌٌلد ٌ ا ىٌا ا ٌإسث ١ . □ ذِ ا رٌشاس

ٌتاء اٌ □ذٌز وٌاسز طث ١□ ١ح ذ□عض زٌ الا □ حّ □ ذ□ذ ٠ذ ا ٌّال□ ا عٌغشاف ١ح ٌاخشاض ا □ ٌ اِخ ا عٌغشاف ١ح ٌا ٌّطف ١ح لا ذٌاف □ذدج ٌار ا رٌ□ا □ زٌ ا خٌّشظاخ □ ٌ واف ا سٌّ ٠اخ س ٌاءا □ی ١ح وا ذٌ اٌ □ ٌّ سِر ٌ ا مٌطا□ ا خٌاص .

اِ ذمذ ٌ □ٌذ ٠ذ الأسثاب ا رٌ□ س ١شدُ شش□ٌا تا رٌفظ ١ لا□ماً، ذث ١ أ اٌ إن □اظحً اِسحً ٌ □حً □ٌا عٌح زٌ ا شٌاو ٌ ا قٌع ٌاخ □ طش ٠ك اترىاس طشق ظذ ٠ذج □ر دّ ٠ □ ٌ إ عٌاصاخ ٌ ذط ٌساخ ا ثٌ ١ح ا رٌ□ر ١ح رٌى ٌ ٌّظ ١١١ □ ٌ اِخ ا □ٌذ ٠صح ٌخسخ ١ش اٌ عٌ □ ٌ ادخاي ,ٌ □ا عٌح، ٌ ذ□١، ٌ □شع، ٌ اخشاض ا □ ٌ اِخ ا عٌغشاف ١ح ٌا ٌّطف ١ح لا ذٌاف □ذدج ٌظذٌ رٌا تا شٌى اظٌ□ ١ □ ٌ إسساي زٌ ا □ ٌ اِخ ٌ سٌ ا □ظ ٌي □ ١ٌا ف□ ا ٌّلد ٌ ا ىٌا ا إٌسث ١ تاسرخذا □ ا □ ٌ اِخ ا عٌغشاف ١ح ٌ ستطٌا □ ا □ حّ إداسج ا □ٌلالاخ ذر □ا عٌح زٌ ا قٌع ٌاخ ٌ ا شٌاو ٌالإ ظاتح □ ٌ وص ١ش ا رٌسأ ٌلاخ ص ا رٌ ذخض ا رٌ□ذ ٠ذ ,ٌ ا مٌ ١اساخ , ٌ ا ٌّل□ , ٌ أ سئة ا طٌّشق ر ةٌ تالإ□اف ا ٌّ اسرخذا ا □ ٌ اِخ الاساس ١ح ا ٌّظ ٌدج ف□ □أ اداسج ا □ٌلالاخ . ٌ ذ□ذ زٌ ا شٌسا حٌ ذطث ١ما □ ١١ شٌاو ذ□ذز □ ١١ ف□ ايلطا□ ا □ٌا ٌ ا خٌاص □ ٌ ٌ ٌ ؤسساخ □ی ١ح (Enterprise) □ذ س ٌاء , ف ٌ□ خثشج اِسساخ □ ١ح ٌال□ شِاس ٠ □ شٌشواخ وث ١شج .

إ ا ٌّذف الأساس□ ٌز ا شٌسا حٌ ٌ ذظ ١ ٌرض رٌى١ ت ١١ □ حّ ادساج ا □ٌلالاخ ٌ □ ا □ ٌ اِخ (ا عٌغشاف ١ح تاسرخذا ١ عٌ ٌرض ٠ ٌ ذى ٌ صح ٌذ ا □ اِخ ا □ ٌظ ١١١ ٌ رٌى ١ح ا رٌ□ر ١ح ا ثٌ اخ اٌد (Hybrid ا□ و طفاخ اطٌ □ا ٠ ٌ □٠ □ ٌ ذ ٌ ٠ی ٌ ٌرض رٌی ٠ؤدٌ ا ٌغائف تظ ٌسج رٌی ح □ٌا عٌح ا قٌع ٌاخ ٌ ا شٌاو ا رٌ□ ذ□ظ □ ١١ □ ٌ أسع ا ٌال□ ف□ ا مٌطا□ ١١ □ٌا ٌ ا خٌاص .

ٌف□ ا خٌرا , فئ ذطث ١ك فىشج ا ٌرض ا مٌرشغ سرسا□ذ ف□ سش□ح □ ١ح اذخار ا مٌشاس ٌ ا ٌطٌي ا ٌ ا □ ٌ اِخ ا ٌّطف ١ح تذلح □ا ١ح. إ□افح إ ٌ ر ةٌ ، فئ س ١ □ □ ٌ □فع ا ٌّلد ٌا عٌذ ٌذخف ١غ ا رٌىا ١ف ا إٌذعح □ ذظ ١ ا ٌ شٌاء و □أ □ □ ٌ ذ□ .ٍ

Chapter One

Used to be	Abbreviation
Line Of Business	LOB
Customer Relationship Management.	CRM
External Relationship Management	xRM
Geographic Information System	GIS
Enterprise Resource Planning	ERP
Supply Chain Management	SCM
Structured Query Language	SQL
Service Object Manager	SOM
Application Programming Interfaces	API
Data Source Name	DSN
Data Base	DB
Human Resource Management	HRM
Microsoft Developer Network	MSDN
Dynamic Link Library	DLL
Transmission Control Protocol	TCP
Internet Protocol	IP
Global Positioning System	GPS
Environmental Systems Research Institute	ESRI
Microsoft	MSFT
Application service provider	ASP
Data Warehouse	DW
Decision Support Systems	DSS
Rational Unified Process	RUP
Electronic Commerce	EC
Electronic Data Interchange	EDI
Instant Messaging	IM
Knowledge Management	KM
Object-Oriented Programming	OOP
Open Source Software	OSS
Outsourcing	OUTS
Radio Frequency Identification	RFID
Infrastructure as a Service	IaaS
Platform as a service	PaaS
Software as a service	SaaS
Return On Investment	ROI
Total Cost Ownership	TCO
Protected Geographical Indication	PGI
Web Coverage Service	WCS

Figure 4-12 Architecture of integration model

Table 4-1 Components of the integration model

All of the above components are detailed below.

4.3.1 User Experience Services

Customer experience is the internal and subjective response customers have to any direct or indirect contact with a company (Microsoft, 2010). Direct contact generally occurs in the course of purchase, use, and service and is usually initiated by the customer. Indirect contact most often involves unplanned

encounters with representations of a company's products, services, or brands and takes the form of word-of-mouth recommendations or criticisms, advertising, news reports, reviews, and so forth.

4.3.2 Integration Services

xRM is an increasing penetration with the new possibilities opened to access to customers because recent developments of voice and data communication infrastructures. The integration of GIS with xRM mainly in the field support area may have enormous value for field technicians, service managers and customers to improve their working conditions and relations. Commercial xRM systems have little direct support for GIS, which must be coupled and have limited interaction. The technological tendency goes in favor of interoperation with standard geo-information geo-processing services that may be provided by third parts. GIS and telecommunication communities are glimpsing a big future for GIS and they have promoted strong standardization initiatives for specialized services, some of them will be directly provided by telecommunication operators. These services will ease and make cheaper the incorporation of GIS in xRM systems (Microsoft, 2010).

4.3.3 Data Modeling Services

Data modeling is a method used to define and analyze data requirements needed to support the business processes of an organization. The data requirements are recorded as a conceptual data model with associated data definitions. Actual implementation of the conceptual model is called a logical data model. To implement one conceptual data model may require multiple logical data models. Data modeling defines not just data elements, but their structures and relationships between them.

Data modeling techniques and methodologies are used to model data in a standard, consistent, predictable manner in order to manage it as a resource. The use of data modeling standards is strongly recommended for all projects requiring a

standard means of defining and analyzing data within an organization, e.g., using data modeling:
1. To manage data as a resource;

2. For the integration of information systems;

3. For designing databases/data warehouses (Microsoft, 2010)

Data modeling may be performed during various types of projects and in multiple phases of projects. Data models are progressive; there is no such thing as the final data model for a business or application. Instead a data model should be considered a living document that will change in response to a changing business. The data models should ideally be stored in a repository so that they can be retrieved, expanded, and edited over time. I determined two types of data modeling:
1. **Strategic data modeling:** This is part of the creation of an information systems strategy, which defines an overall vision and architecture for information systems is defined. Information engineering is a methodology that embraces this approach.

2. **Data modeling during systems analysis:** In systems analysis logical data models are created as part of the development of new databases.

Data modeling is also a technique for detailing business requirements for a database. It is sometimes called database modeling because a data model is eventually implemented in a database (ESRI, 2009)

4.3.4 Extensibility Services

The xRM Web application and any other client applications provided with the xRM, such as Deployment Manager, use APIs available through xRM Web services to perform actions in xRM. When writing code to perform actions in xRM, you should use APIs documented in the xRM SDK. These Web services provide strongly typed access to all entities in xRM, including custom entities and attributes.
The xRM Asynchronous Service runs on the xRM Server. This service responds to events, schedule events, and runs processes. Workflow rules can include actions which invoke class methods that are contained in .NET assemblies.
Then I use Plug-ins to register .NET assemblies to subscribe to a published set of events and to have the code run when the event occurs. Plug-ins are the way that custom business logic, including data integration with other systems, can be achieved.
All client programming code is stored as metadata in the xRM database. This enables the client programming to be transported easily from one deployment to another and also for the code to function in the client machine. xRM does not support modification of the files included in the application. All client code must be added in the locations specified in the Software Development Kit (SDK). Customizations must be made using the tools provided in the Web application, by importing customizations in an XML file or, in some circumstances, by editing customization files. When forms are rendered in either the Web or Outlook clients, the code is included and is executed on the client computer when the designated events occur (Microsoft, 2010).

4.3.5 Service Oriented Architecture (SOA)

The general benefits of SOA can be applied directly to xRM applications. In order to understand why these benefits are so critical, it is important to understand a few key principles of xRM applications:

 xRM applications usually require integration with other systems, such as GIS

 xRM solutions are almost never entirely from one vendor; they are typically a combination of multiple vendor systems and some home-grown functionality

 xRM functionality is multi-channel-addressing customers on the web, over the phone or in-person

There is one more principle that most customers have traditionally faced: xRM solutions are time-consuming and costly to configure and deploy. The main benefit of SOA is that it invalidates this third “principle” by enabling quicker, easier customization, integration, and maintenance.

The platform is the heart of the integration model system. This platform supports smaller deployments and can scale for application service provider models also. The security mode protects the platform from unauthorized access across the Web. The main platform components are as follows:

 SQL Server database, Geodatabase

 Web services

 System services (workflow, metadata, and integration)

 A query processor that supports the entity model

 Secured ad hoc queries that use an XML fetch statement to protect the physical database

 Plug-ins for business logic extensibility

 Reporting services

Architecture developing an application that uses the xRM server, and use GIS Web services to communicate with the underlying platform layer.
The server platform is responsible for creating domain-specific objects. In xRM, these objects include contact, lead, opportunity, account and business unit, plus GIS information as captures, stores, analyzes, manages, and presents data that are linked to location(s). The goal of the platform is to implement the service-specific rules by manipulating and combining the underlying domain objects.

The platform does not impose business-specific logic. This layer imposes only generic domain constraints. It contains the building blocks for an application, but by itself is nothing more than a collection of related objects. However, the interaction between those objects within the domain can be assumed to implement more extensible logic such as the quote-to-order-to-invoice processing and pricing logic.

Chapter Five

CHAPTER 5
Conclusion and Future Work

5.1 Introduction

This chapter includes the conclusion of the thesis, the discussion about the Framework Model of Integration xRM with GIS and the future work proposed.

5.2 Conclusion

When thinking about the business value of LOB applications, businesses should consider not just the value of individual applications, but the ability of application frameworks, tools, and infrastructure to provide value to the business. xRM provides a framework for the rapid delivery of numerous LOB applications with a common hardware, licenses, and IT resources, providing organizations with economies of scale and skills that maximize the value of their IT investments.

xRM can be much more than just a toolset that solution builders use to develop custom business applications. It is that, of course, but the technology has the potential to enable the solution builder to improve the operating performance of its business, enjoy newfound competitive advantage, and cultivate long-term strategic relationships with clients. The truth is that today, solution builders may not have much choice but to do just that. The stakes are too high.

Providing the xRM integrated with GIS gives the user a great power of knowledge and trust to the client in the organization, geographical data is very useful with the relationship management frameworks, due to the big change in the business needs, the GIS systems are required for a wide range of business types.

From the experience in large projects for international companies and government agencies, it has become an urgent need to use the systems that don't only store only normal data, but also geographic information, which make the user able to get the full picture about the client as much as possible.
Taking advantage of the Cloud Computing and Web Services which is the latest and most developed technology in the present time, we were able to create Hybrid Framework which includes the best properties from both systems XRM & GIS.
The main objective is to provide accurate and quick information to help decision-makers to take the right decisions in a timely manner, and provide a work environment that uses the latest modern technology, which leads to reduce the use of individual systems, which work as stand alone systems to become an integrated system that works nicely.

5.3 Future Works

The future work in the field of xRM and GIS are still a new and developing continuously and rapidly by using the cloud technology and its applications

The main recommendation for future work is summarized as follows:

1. Use satellites that have higher accuracy and more developed than now days, where for the commercial use, we only can see pictures of the weak satellites and the better quality is kept for other purposes such as governmental uses. So it would be better if the access to the better quality satellites would be open.

2. Add data for the areas that are not covered by the geographical survey and where there is not enough information to get to them. Like areas of a confidential nature, because sometimes we need to know that this is a confidential areas not only have a damaged image of these areas, which someone might think that the a corruption in the image itself, or in the satellite.

3. Create/allow access to the satellites that gives real-time images on any requested place, which gives the users more confidence in the GIS system they might be using, and of course more accurate information.

4. Apply the application on natural disasters and post-natural disaster areas affected and the impact of disasters by linking them with the time dimension to become possible to predict

5. Provide information about the non-visible dimensions in the system, such as wind speed, for example and its impact on spreading a contagious or damage to a chemical terrorist attack

6. To apply all GIS layers in the system, as in this application I only use layer one from the GIS, where in GIS model there are six layers as shown below:
a. Transportation

b. Land Use

c. Census Tracts

d. Structures

e. Postal Codes

f. Raster Imagery
7. Apply the system on other planets in the solar system and use it in the areas of space, which would be very useful for the astronomers and their studies, and there would be many new discoveries in astronomy.

The implementation of the proposed model can be applicable in the following sectors as well:
1. Government - citizenship and citizens and their information

2. Government - the spread of diseases and epidemics

3. Government - earthquakes and natural disasters

4. Private sector - manufacturing, supply chain orders

5. Private sector - aviation and shipping

6. Private sector - manufacturing, transport

REFERENCES

Ambler, S. (2005). A manager's introduction to the Rational Unified Process (RUP). Available at: http://www.ambysoft.com/downloads/managersIntroToRUP.pdf [Accessed 22 September 2010]

Anderson, G. & Moreno-Sanchez, R., 2003. Building web-based spatial information solutions around open specifications and open source software.
Transactions in GIS, 7 (4), 447-466.

Aaron Yetter, Hoss Hostetler, Justin Mathena (2008). *Success with Microsoft Dynamics CRM 4.0*. USA: Apress.

Bass, L., Clements, P., Kazman, R. 1998 . *Software Architecture in Practice.*
SEI series in software engineering. Reading, Massachusetts: Addison-Wesley.
452 p. ISBN 0-201-19930-0.

Ben-Natan, R. (1995) CORBA a guide to the Common Object Request Broker Architecture, McGraw-Hill, New York.

Boehm, B. 2002, *Perfect Predictions in Economic Dynamical Systems with Random Perturbations*, (with J. Wenzelburger), Macroeconomic Dynamics, 6(5), 687–712.

Boehm, B. & Turner, R. (2003) Using risk to balance agile and plan-driven methods. IEEE Computer, 36(6), 57-66.

Bowers, J., May J., Melander, E., Baarman, M. & Ayoob A. (2002). Tailoring XP for large systems mission critical software development, Proceedings of the Second XP Universe and First Agile Universe Conference on Extreme Programming and Agile Methods – XP/Agile Universe 2002, August, 100-111.

Boulding, W., Staelin, R., Ehret, M., and Johnston, W. J. (2005). A Customer Relationship Management Roadmap: *What is Known, Potencial Pitfalls, and Where to Go*. *Journal of Marketing*, 69 (4), 155-166.
Bramley, C. & Kirsten, J.F., 2007. *Exploring the rationale for protecting geographical indicators in agriculture*. Agrekon*,* 46 (1), 69 - 93.

Brite Global. (2010). *xRM explained* . Available: http://www.briteglobal.com/Services/xrm/Pages/xrm-explained.aspx. Last accessed 20th Aug 2010.

Carver, S.J. ed. 1999. *Developing web-based gis/mce: Improving access to data and spatial decision support tools.,* New York: Ashgate.

Chartier, R. (2000) Application Architecture: An N-Tier Approach, http://www.15seconds.com/issue/011023.htm, Last Access 08/2010

Cheung, K.-H., Yip, K.Y., Townsend, J.P. & Scotch, M., 2008. Hcls 2.0/3.0: Health care and life sciences data mashup using web 2.0/3.0. *Journal of Biomedical Informatics,* 41, 694-705.

Dangermond, J., 2002. Web services and gis. Geospatial Solutions, 12 (7), 56.

David J. Cowen, 1988 *GIS versus CAD versus DBMS: What Are the Differences?*
Department of Geography and SBS Lab, University of South Carolina, Columbia, SC 29208

Densham, P.,J. 1992. Spatial Decision Support Systems. *Geographical Information Systems*, Volume 1 : PrinCiples, edited by Maguire, D.J., Goodchild, M.F. and Rhind, D.W., Longman, 403-412.

Drummond, W.J. & French, S.P., 2008. The future of gis in planning - converging technologies and diverging interests. *Journal of American Planning Association,* 74 (2), 161-174.

Dueker K J, 1979, Land resource information systems: a review of fifteen years experience. Geo-Processing

ESRI 2009, *GIS and Mapping Solutions for Developers* ESRI Developer Network Available at: http://edn.esri.com/ [Accessed 22 September 2010]

Finch 1987, *Towards a national digital topographic data base*. Unpublished PhD thesis, University of London.

Fruhling, A. & Vreede, G. (2006). Field experiences with extreme programming: Developing an emergency response system. Journal of Management Information Systems, 22(4), 39-68.

F.P. Brooks 1995, et al. *Defense Science Board Task Force Report on Military Software*, Office of the Under Secretary of Defense for Acquisition, Washington, DC 20301, Sept. 1995

Gao, S., Mioc, D., Anton, F., Yi, X. & Coleman, D.J., 2008. Online gis services for mapping and sharing disease information. *International Journal of Health Geographics,* 7, 8.

Geoffrey Fox Computer Science 2001, *Informatics and Physics*, Indiana University: Community Grid Computing Laboratory, 501 N Morton Suite 224, Bloomington IN 47404

Hecht, L., 2002b. Web services are the future of geo-processing. *GeoWorld,* 15 (6), 23-4.

Mike Snyder, Jim Steger (2006). *Working with Microsoft Dynamics(TM) CRM 3.0*. USA: Microsoft Press. 35.

Juyun Joey Cho, 2010 *An Exploratory Study on Issues and Challenges of Agile Software Development with Scrum* Utah State University, Logan, Utah
Light, B. 2003. CRM packaged software: a study of organizational experiences.
Business Process Management, 9 (5), 603-616.

Maguire D.J., Dangermond J., 1991. The functionality of GIS. In: Maguire D. J. Goodchild M. F., Rhind D. W. (eds.) *Geographical Information Systems: principles and applications*. Longman London, pp., Vol 1.

Mahmoud Hussain, (2010). *Interview with the author.* 27 May 2010. Petra International Hotel Al aqaba

Marble, D.F. (1989) Letter to the Editor. *Photogrammetric Engineering and Remote. Sensing* 55(4): 434–435.

Makeen Siam, Eng (2010*). Interview with the author.* 17 May 2010. Jordan Aviation (JATE) Airlines.

Microsoft Corporation Website, *Microsoft Dynamics CRM 4.0 system requirements,* [Online]. Available at:
http://www.microsoft.com/spain/dynamics/crm/producto/requisitos_sistema.mspx
[Accessed 22 September 2010]

Microsoft Press, *IT Books | Computer Books | Microsoft Press Books | Online Books* 2010

Morgan, R., and Hunt, S. 1994. The commitment-trust theory of relationship marketing. *Journal of Marketing*, 58 (3), 20-38.

NYS, 2001. Project Management Guidebook . *System Implementation* , Section III:6 , 177

OMG (2000) Meta Object Facility (MOF) Specification,
http://www.omg.org/cgi-bin/doc?formal/00-04-03.pdf, last access b08/2002

Parrish, A., Smith, R., Hale, D., & Hale, J. (2004). A field study of developer pairs: Productivity impacts and implications. *IEEE Software*, 21(5), 76-79.

Payne and Frow, (2006) *Customer Relationship Management*: from Strategy to Implementation, "Journal of Marketing Management", 22(1/2), 135-168

Rhind D.F., (1987), *Recent Developments in Geographical Information systems in the UK.* International Journal Geographical. Information. Systems, 1(3), 229-242.

Rhind D.W. And Mounsey A.R., 1989. A GIS research agenda, International Journal of Geographical Information Systems 2: 23-8

Rhind D.W. 1991, Global databases and GIS. In: Foster M.J., Shand P.J. (eds.). *The Association for Geographic Information Yearbook 1990*. Taylor & Francis and Miles Arnold, London, pp. 218-23.

Ryals, L., and Knox, S. 2001. Cross-functional issues in the implementation of relationship marketing through customer relationship management. *European Management Journal*, 19 (5), 534-542.

Ryals, L., and Payne, A. 2001. Customer relationship management in financial services: towards information-enabled relationship marketing. *Journal of Strategic Marketing*, 9 (1), 3-27.

Sakamoto, A. & Fukui, H. (2004). Development and application of a livable environment evaluation support system using Web GIS, *J. of Geographical Systems*, 6(2), pp. 175-195.

Sawicki, D.S. & Craig, W.J., 1996. The democratization of data: Bridging the gap for community groups. *Journal of American Planning Association,* 62 (4), 512-524.

Saunders, 2003, *Research methods for business students*, Financial Times/Prentice Hall, Harlow

Schwaber, K., & Beedle, M. (2002). Agile software development with Scrum, Upper Saddle River, NJ: Prentice Hall.

Szyperski, C. 1997. Component Software. Beyond Object-Oriented Programming. New York: Addison Wesley Longman Ltd. 411 p. ISBN 0-201-17888-5.

Tomlinson C. D., 1972 Geographical information systems and Cartographic Modeling. Prentice Hall, Englewood Cliffs, New Jersey

Weijun, X. & Zhimig, W, 2007, *Supplier selection with multiple criteria in volume discount environments*, Omega, Vol. 35, Issue 5, p. 494-504

Wikipedia. (2010). *Presentation Layer.* Available: http://en.wikipedia.org/wiki/Presentation_Layer Last accessed 20th Aug 2010

Ye Zhelu 2009, *A Web-Based geographical information system prototype on Portuguese traditional food products.* William University New Jersey

Zablah, A. R., Bellenger, D. N., and Johnston, W. J. 2004. An evaluation of divergent perspectives on customer relationship management: *Towards a common understanding of an emerging phenomenon. Industrial Marketing Management*, 33 (6), 475-489.

APPENDICES

APPENDIX A

The code shows how does the business layer represent and manage the data flow and business requests into the proposed model.

```
Imports Artem
Imports Artem.Web.UI.Controls
Imports System.Data
Imports System.Data.SqlClient
Imports System.IO

Partial Class _Default
    Inherits System.Web.UI.Page
    Protected Sub Page_Load(ByVal sender As Object, ByVal e As System.EventArgs)
Handles Me.Load
        Dim AID As String = Request("AID")
        Label1.Text = AID
        Dim address As String = Request("Addr")
        GMap.Address = address
        GMap.Markers.Clear()
        Dim Mark1 As New GoogleMarker
        Mark1.Address = address
        Mark1.Text = "City: " & address
        GMap.Markers.Add(Mark1)
        ds.Clear()
        cmd = New SqlCommand("GET_Locations", conn)
        cmd.CommandType = CommandType.StoredProcedure
        Dim lbl As Label
        lbl = CType(Page.FindControl("Label1"), Label)
        cmd.Parameters.AddWithValue("@AID", lbl.Text)
        adapt.SelectCommand = cmd
        adapt.Fill(ds)
        For i As Integer = 0 To ds.Tables(0).Rows.Count - 1
            Dim Mark As New GoogleMarker
            Mark.Latitude = ds.Tables(0).Rows(i)(2)
            Mark.Longitude = ds.Tables(0).Rows(i)(3)

            GMap.Markers.Add(Mark)

            GMap.Markers(i + 1).Text = "Location: " & (i + 1).ToString
        Next
        ds.Clear()
        cmd = New SqlCommand("GET_Locations", conn)
        cmd.CommandType = CommandType.StoredProcedure
        cmd.Parameters.AddWithValue("@AID", AID)
        adapt.SelectCommand = cmd
        adapt.Fill(ds)
        DG.DataSource = ds.Tables(0)
        DG.DataBind()
    End Sub
```

```
    Protected Sub btnSave_Click(ByVal sender As Object, ByVal e As System.EventArgs)
Handles btnSave.Click
        ds.Clear()
        cmd = New SqlCommand("INSERT_Locations", conn)
        cmd.CommandType = CommandType.StoredProcedure
        Dim Str() As String
        Str = __info.Text.Split("/")
        Dim lbl As Label
        lbl = CType(Page.FindControl("Label1"), Label)
        cmd.Parameters.AddWithValue("@AID", lbl.Text)
        cmd.Parameters.AddWithValue("@Latitude", Str(0))
        cmd.Parameters.AddWithValue("@Longitude", Str(1))

        adapt.SelectCommand = cmd
        adapt.Fill(ds)
        For i As Integer = 0 To ds.Tables(0).Rows.Count - 1
            Dim Mark As New GoogleMarker
            Mark.Latitude = ds.Tables(0).Rows(i)(2)
            Mark.Longitude = ds.Tables(0).Rows(i)(3)
            GMap.Markers.Add(Mark)
        Next

        Response.Redirect(Request.Url.AbsoluteUri)
    End Sub
    Protected Sub DG_SelectedIndexChanged(ByVal sender As Object, ByVal e As
System.EventArgs) Handles DG.SelectedIndexChanged
        If DG.SelectedIndex <> -1 Then
            Dim AID As String = Request("AID")
            ds.Clear()
            cmd = New SqlCommand("DELETE_Locations", conn)
            cmd.CommandType = CommandType.StoredProcedure
            cmd.Parameters.AddWithValue("@ID",
DG.DataKeys(DG.SelectedIndex).Values("ID"))
            cmd.Parameters.AddWithValue("@AID", AID)
            adapt.SelectCommand = cmd
            adapt.Fill(ds)
            DG.DataSource = ds.Tables(0)
            DG.DataBind()
            Response.Redirect(Request.Url.AbsoluteUri)

        End If

    End Sub

    Protected Sub DG_RowDataBound(ByVal sender As Object, ByVal e As
System.Web.UI.WebControls.GridViewRowEventArgs) Handles DG.RowDataBound
        If e.Row.RowType = DataControlRowType.DataRow Then
            e.Row.Cells(2).Text = "Location: " & e.Row.RowIndex + 1
            e.Row.Attributes.Add("onclick",
Page.ClientScript.GetPostBackEventReference(sender, "Select$" +
e.Row.RowIndex.ToString()))
        End If
    End Sub
End Class
```

APPENDIX B

Used to be	Abbreviation
Line Of Business	LOB
Customer Relationship Management.	CRM
eXtended Relationship Management.	xRM
Geographic Information System	GIS
Enterprise Resource Planning	ERP
Supply Chain Management	SCM
Structured Query Language	SQL
Service Object Manager	SOM
Application Programming Interfaces	API
Data Source Name	DSN
Data Base	DB
Human Resource Management	HRM
Microsoft Developer Network	MSDN
Dynamic Link Library	DLL
Transmission Control Protocol	TCP
Internet Protocol	IP
Global Positioning System	GPS
Environmental Systems Research Institute	ESRI
Microsoft	MSFT
Application service provider	ASP
Data Warehouse	DW
Decision Support Systems	DSS
Rational Unified Process	RUP
Electronic Commerce	EC
Electronic Data Interchange	EDI
Instant Messaging	IM
Knowledge Management	KM
Object-Oriented Programming	OOP
Open Source Software	OSS
Outsourcing	OUTS
Radio Frequency Identification	RFID
Infrastructure as a Service	IaaS
Platform as a service	PaaS
Software as a service	SaaS
Return On Investment	ROI
Total Cost Ownership	TCO
Protected Geographical Indication	PGI
Web Coverage Service	WCS
Web Map Service	WMS

User Experience Components

- Office Integration
- Outlook Sync
- Standard Clients & Devices
- Common Navigation & SiteMap

Access and Security Components

- Active Directory
- Access Controls / Authentication
- VPN-less Accessible (SSL)
- Bulk User Management

Milestones for Computer-based GIS:

APPENDIX C

The characteristics, strengths, and weaknesses of the conventional and agile methods.

Table 1-6 Comparisons between Conventional and Agile Methods (Agile Alliance, 2003)

Used to be	Abbreviation
Line Of Business	LOB
Customer Relationship Management.	CRM
eXtended Relationship Management.	xRM
Geographic Information System	GIS
Enterprise Resource Planning	ERP
Supply Chain Management	SCM
Structured Query Language	SQL
Service Object Manager	SOM
Application Programming Interfaces	API
Data Source Name	DSN
Data Base	DB
Human Resource Management	HRM
Microsoft Developer Network	MSDN
Dynamic Link Library	DLL
Transmission Control Protocol	TCP
Internet Protocol	IP
Global Positioning System	GPS
Environmental Systems Research Institute	ESRI
Microsoft	MSFT
Application service provider	ASP
Data Warehouse	DW
Decision Support Systems	DSS
Rational Unified Process	RUP
Electronic Commerce	EC
Electronic Data Interchange	EDI
Instant Messaging	IM
Knowledge Management	KM
Object-Oriented Programming	OOP
Open Source Software	OSS
Outsourcing	OUTS
Radio Frequency Identification	RFID
Infrastructure as a Service	IaaS
Platform as a service	PaaS
Software as a service	SaaS
Return On Investment	ROI
Total Cost Ownership	TCO
Protected Geographical Indication	PGI
Web Coverage Service	WCS
Web Map Service	WMS

User Experience Components	**Access and Security Components**
□ Office Integration	□ Active Directory
□ Outlook Sync	□ Access Controls / Authentication
□ Standard Clients & Devices	□ VPN-less Accessible (SSL)
□ Common Navigation & SiteMap	□ Bulk User Management

APPENDIX D

Used to be	Abbreviation
Line Of Business	LOB
Customer Relationship Management.	CRM
eXtended Relationship Management.	xRM
Geographic Information System	GIS
Enterprise Resource Planning	ERP
Supply Chain Management	SCM
Structured Query Language	SQL
Service Object Manager	SOM
Application Programming Interfaces	API
Data Source Name	DSN
Data Base	DB
Human Resource Management	HRM
Microsoft Developer Network	MSDN
Dynamic Link Library	DLL
Transmission Control Protocol	TCP
Internet Protocol	IP
Global Positioning System	GPS
Environmental Systems Research Institute	ESRI
Microsoft	MSFT
Application service provider	ASP
Data Warehouse	DW
Decision Support Systems	DSS
Rational Unified Process	RUP
Electronic Commerce	EC
Electronic Data Interchange	EDI
Instant Messaging	IM
Knowledge Management	KM
Object-Oriented Programming	OOP
Open Source Software	OSS
Outsourcing	OUTS
Radio Frequency Identification	RFID
Infrastructure as a Service	IaaS
Platform as a service	PaaS
Software as a service	SaaS
Return On Investment	ROI
Total Cost Ownership	TCO
Protected Geographical Indication	PGI
Web Coverage Service	WCS
Web Map Service	WMS

User Experience Components
- Office Integration
- Outlook Sync
- Standard Clients & Devices
- Common Navigation & SiteMap
- User Functionality & Tools
- Offline Capabilities, without map
- Language Packs
- Accessibility

Access and Security Components
- Active Directory
- Access Controls / Authentication
- VPN-less Accessible (SSL)
- Bulk User Management
- Role Management
- Role-based Security
- Hierarchical Security
- Deep data controls

Data Modeling Components
- SQL Server automation
- Table creation (entities)
- Data Relationships (n:n)
- Referential Integrity Rules
- Attribute definition & rules
- Metadata management

Extensibility Components
- Microsoft SQL Server/SRS/SAS
- Microsoft Excel
- Report Creation Wizard
- Scheduled & Offline Reporting
- Ad Hoc Analytics
- Dashboards / KPIs

APPENDIX E

I need your help to answer the questions below if you can:
1. When you use CRM and ERP systems at first time?
2. Is CRM was a part from ERP solution that you used?
3. What are challenges/problems faced during business and technological intervention?
4. What method used to solve issues/problems related to CRM adoption?
5. Which departments have been involved in CRM system? (Marketing, Sales, Customer Services, Relationship management, other)
6. What are the expected benefits from CRM?
7. In your opinion, which issues need attention during CRM implementation?
8. Did the customer number increase after CRM adoption? Can you give a percentage?
9. Did you use any GIS tool?
10. In your opinion, is there a befits from integration CRM with GIS to capture customer locations?
11. Do you have a method of tracking potential business before concluding that there is a possibility of creating a business relationship with either individuals or accounts?

12. What characteristics might you want to capture?

13. Do you track information about accounts (companies)? If so what characteristics are important?

14. What characteristics for contacts would you like to capture? Do you track any demographic information, for example gender, education, or things like spouse's and children's names?

Charts & Graphs: